GEAR TRAINS

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Abstract of **GB1310417**

1310417 Toothed gearing SKODA NARODN1 PODNIK 18 June 1970 [19 June 1969] 29597/70 Heading F2Q In a gear train having a gear-wheel 6<SP>11</SP> formed of two parts 6<SP>11</SP>a and 6<SP>11</SP>b having oppositely inclined oblique teeth which are meshed by three two-part pinions 3<SP>11</SP>a and 3<SP>11</SP>b, the two parts 6<SP>11</SP>a and 6<SP>11</SP>b are connected respectively to a torsion shaft 7 and a torsion tube 8 having their ends secured to a hub 11 of a toothed coupling 17 attached to a shaft 14. The two-part pinions 3<SP>11</SP>a and 3<SP>11</SP>b are secured to shafts 16 which carry pinions 3<SP>1</SP> which mesh a gear-wheel 2<SP>1</SP> on a shaft 13. In a modification, the torsion shaft 7 and torsion tube 8 are interconnected by a toothed coupling at their outer ends. In another modification, an internally toothed gear 6<SP>11</SP> is connected to shaft 14 and meshes pinions 3<SP>11</SP>, Fig. 3. An epicyclic gear arrangement is shown in Fig. 4.

FIG. 1

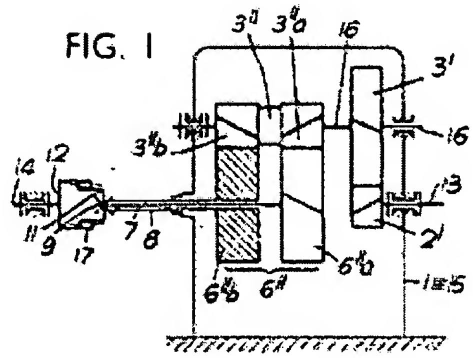


FIG. 3

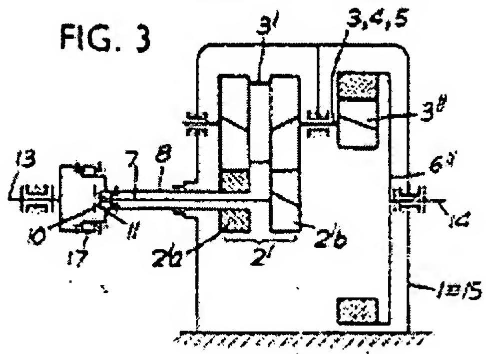
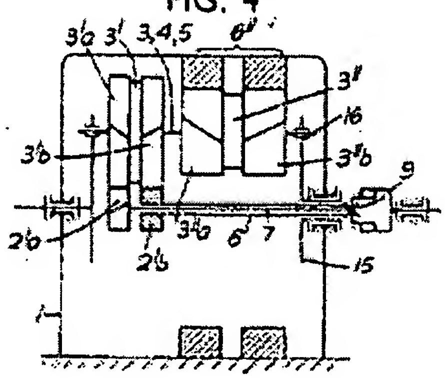


FIG. 4



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(54) IMPROVEMENTS IN OR RELATING TO GEAR TRAINS

(71) We, SKODA, NARODNI PODNIK, a Czechoslovakian Body Corporate, of Plzen, Czechoslovakia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to gear trains.

Forms of constructions of gear trains having a plurality of pinions in mesh with a gear wheel, the pinions being in two-parts are already known where various types of compensation device are used in an endeavour to obtain an even distribution of the load. However from the point of view of actual assembly these forms of construction appear to be sterostatically indeterminate i.e. there is not a uniform distribution of the power supplied to the pinions and the forces on the gear teeth of a particular pinion cannot be determined.

Certain known types of gear trains with two-part pinions are stereostatically indeterminate constructions because of the effect of the excessive number of degrees of freedom of the system.

In the case of stereostatically indeterminate gear trains having an excessive number of degrees of freedom various difficulties may arise in operation owing to the excessive mobility of the individual members (falling out of mesh of the gears, possibly of gears jamming, and so on). For this reason these transmission gears are not operationally acceptable.

In addition, certain known gear trains with two part gear wheels have been proposed only permitting the minimum necessary mobility of the system, which gear train employ a compensation mechanism of a mechanical or elastic design.

A disadvantage of this type of construction of gear train lies in the fact that the mobility of the system is only a minimum, and is affected even further by the friction occurring because of the contact between individual members of the gears.

Besides the known gear trains mentioned above, there are also known types of gear trains with two-part gear wheels which are stereostatically indeterminate because of the insufficient mobility of the connections of the individual members. In the case of these gear trains with two-part pinions difficulties in operation must necessarily occur, such as for instance premature wear of one of the pinions, unsatisfactory seating of the individual parts of the gearing and so on, because of the stereostatic indeterminateness of the system.

One advantage of the present invention is for instance the stereostatic determinateness of the design, i.e. a uniform distribution of the power supplied to the individual pinions and an unambiguous determinability of the forces in the gear teeth, and also a simplicity in construction and production, and consequently small dimensions and low weight of the gear train.

According to the invention there is provided a gear train comprising two stages, one stage having a gear wheel which is formed with first and second co-axial parts, and three pinions each of which is likewise formed with first and second co-axial parts, the first parts and the second parts of the gear wheel and pinions respectively meshing and having oppositely inclined oblique teething and the two parts of the gear wheel being connected respectively to a torsion shaft and a torsion tube coupled together at a location remote from the two parts, characterised in that the gear wheel is connected with an external drive shaft or driven shaft by means of a toothed coupling arranged between a hub connected to the torsion tube and a sleeve connected to the external shaft, the two parts of each pinion being fixed against movement relatively to one another, and the second stage of the gear train com-

prising a gear wheel supported against radial and axial movement and meshing with three further pinions each of which is co-axial with and connected to one of said first mentioned pinions respectively.

Examples of embodiments of the invention are indicated in the attached drawings 1 to 4, each of which diagrammatically represent an axial section through a gear train with three two-part pinions (in the drawings only one of the pinions is shown; and the teething of the gears is only shown diagrammatically). In the drawings:

FIGURES 1 and 2 show a section through the gear train with two-part pinions, where a high-speed gear stage is formed by a train of single-part gears and a slow-speed gear stage by a train of two-part gears;

FIGURE 3 is a section where by contrast the high-speed gear stage is formed by a train of two-part gears and the slow-speed stage by a train of single part gears; and

FIGURE 4 is a section through an epicyclic gear with two-part planet pinions and where the teething of the two transmission stages is of the herringbone type.

According to Figure 1 the high-speed stage of the gear system consists of one train, and the slow-speed stage consists of a train of two-part gears, the two parts being interconnected by a mechanism permitting relative rotation. All gears are externally toothed. The carrier 15 of the pinions is fixed, and represents functionally a constituent of the gearbox of the gear train 1. The transmission gear system could be described as a pseudoplanetary or pseudo-epicyclic gear.

The gear wheel 2′ of the high-speed stage is carried by a high-speed shaft 13, which is rotatably supported in the gearbox of the gear system 1. The three pinions of the high-speed stage (only one of which is indicated at 3′) have straight or oblique teething. The three pinions of the slow-speed stage (only one of which is indicated at 3″) are each formed in two parts 3″a and 3″b having oppositely inclined (or herringbone type) teeth. The two parts of each pinion 3″ are secured to a shaft 16 which is rotatably supported in the carrier 15, i.e. actually in the gearbox of the gear system 1. The pininois 3″ of the slow-speed stage mesh with the gear wheel 6″ of the slow-speed stage, which is formed in two parts 6″*a* and 6″*b*, with oppositely inclined teeth. The parts 6″a and 6″b of the gear wheel of the slow speed stage are interconnected by means of a co-axial torsion shaft 7 and torsion tube 8. The torsion shaft 7 and torsion tube 8 are fixed together, for example, by means of a screwed connection arrangement or a cylindrical securing pin. This fixed connection (indicated at 9) makes possible relative rotation of the two parts 6″a and 6″b of the gear wheel of the slow-speed stage 6″*a*. 6″*b* due to twisting of the torsion shaft 7 and the torsion tube 8. At the same time the shaft 7 and tube 8 permit radial movement of the parts 6″a and 6″b within the limits of the bend elasticity of the torsion shaft 7, and tube 8. The ends of the shaft 7 and tube 8 are connected in a hub 11 which is supported in a sleeve 12 by means of a toothed connecting arrangement 17. The sleeve 12 is mounted on a rotatably supported slow-speed shaft 14.

In Figure 2 is shown the connection of the torsion shaft 7 with the torsion tube 8 by means of a toothed coupling 10. Here, by contrast with Figure 1, instead of the fixed connection 9 or the torsion shaft 7 and the torsion tube 8, the said connection is effected by means of the toothed coupling 10.

Figure 3 shows a construction of a gear system with two-part pinions where torsion members are provided between two parts of the gear wheel of the high-speed stage. The parts 2′a and 2′b of the gear wheel of the high-speed stage are again interconnected by means of the torsion shaft 7 and the torsion tube 8. This connection is effected by one of the methods illustrated in Figure 1 or Figure 2. The teeth of the sun wheel of the slow-speed stage are of the oblique type. In this case the gear wheel 6″ is internally toothed and is again connected with the slow-speed shaft 14, which is rotatably supported in the gearbox of the gear train 1. The shafts 16 carrying the pinions 3′ and 3″ are supported so as to be capable of axial movement. In this case the hub 11 of the gear wheel 2′ of the high-speed stage is fixed against axial movement by the toothed connection 17.

Figure 4 represents an epicyclic gear system with two-part planet wheels, where the teething of both transmission stages is of the double oblique or herringbone type.

The shafts 16 carrying planet wheels 3′ and 3″ are axially movable, the sun wheel 2′ of the high-speed stage being likewise axially movable. At the same time, the arrangement of Figure 4 shows an embodiment in which the carrier 15 of the planet wheels 3′ and 3″ is rotatable. It may be said generally that the method indicated of arranging the epicyclic gear with the two-part planet wheels can be effected in the embodiments shown in Figures 1 to 3 with the carrier 15 rotating and *vice versa* in Figure 4 with the carrier 15 stationary, the carrier 15 then being integral with the gearbox of the gear system 1.

It is also possible to modify the sun or gear wheels of the slow-speed stage or the high-speed stage to use either internal or external teething, or possibly to use combinations of these.

WHAT WE CLAIM IS:—

1. A gear train comprising two stages, one stage having a gear wheel which is formed with first and second co-axial parts, and three pinions each of which is likewise formed with first and second co-axial parts, the first parts and the second parts of the gear wheel and pinions respectively meshing and having oppositely inclined oblique teething and the two parts of the gear wheel and the two parts of the gear wheel being connected respectively to a torsion shaft and a torsion tube coupled together at a location remote from the two parts, characterised in that the gear wheel is connected with an external drive shaft or driven shaft by means of a toothed coupling arranged between a hub connected to the torsion tube and a sleeve connected to the external shaft, the two parts of each pinion being fixed against movement relatively to one another, and the second stage of the gear train comprising a gear wheel supported against radial and axial movement and meshing with three further pinions each of which is co-axial with and connected to one of said first mentioned pinions respectively.

2. A gear train as claimed in claim 1, characterised in that the two-part pinions are rotatably supported with respect to a carrier and are held against axial movement relative to the carrier by means of the two part gear wheel the parts of which are fixed against axial movement by means of the torsion shaft and the torsion tube being coupled together at their output end.

3. A gear train as claimed in claim 1 characterised in that the two-part pinions are rotatably supported on a carrier and are held against axial movement with respect to the carrier, the coupling of the torsion shaft to the torsion tube at their output ends being effected by means of a toothed connection.

4. A gear train as claimed in claim 1, characterised in that the two-part pinions are rotatably supported with respect to a carrier and are capable of axial movement relatively thereto, and in that a straight toothed coupling having means for restraining axial movement is provided for coupling a two-part gear wheel to an output shaft.

5. A gear train as claimed in claim 1, characterised in that there are two-part pinions in both transmission stages, each pinion having double oblique or herring-bone, teeth, and being rotatably supported with respect to a carrier so as to be axially movable relatively thereto, the two-part gear wheel of one stage also being axially movable and the two-part gear wheel of the second stage being restrained against axial movement.

6. A gear train arrangement substantially as hereinbefore described with reference to and as illustrated in any one of the accompanying drawings.

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Fig.1.

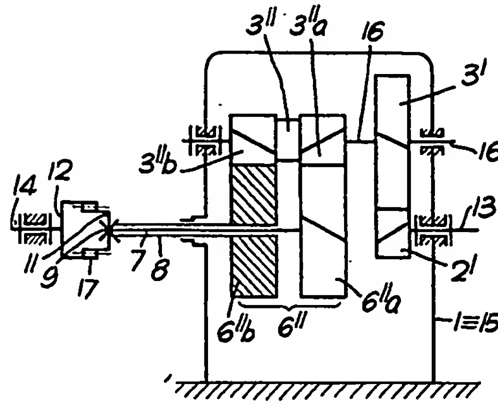

Fig.2.

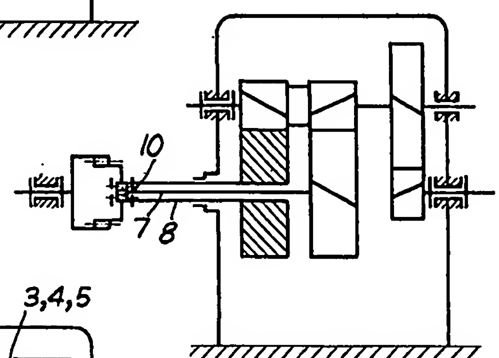

Fig.3.

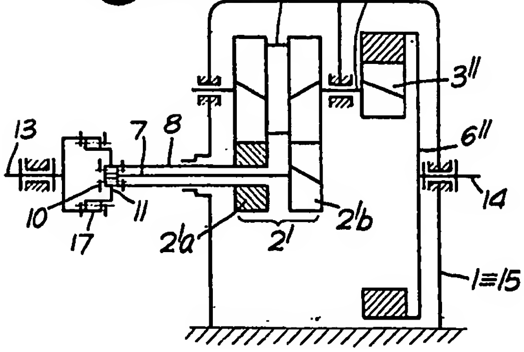

Fig.4.